

SPECIAL CONTRIBUTIONS.

THE RED RIVER FLOOD OF NOVEMBER AND DECEMBER, 1902.

By J. W. CRONK, Observer, Weather Bureau, Shreveport, La.

The causes of this flood were (1) the heavy rainfall over eastern Texas during the early weeks of November; (2) later rainfalls over the watershed of the upper Red River; and (3) the quick succession of two or three heavy and quite general rains, both before and during the flood, over Oklahoma, Indian Territory, and western Arkansas. The combined result of these rains, filling in succession as they did the Sulphur, upper Red, and Little rivers, was a flood in the Red River at a time least expected by the oldest planters. By November 23 conditions had become so threatening that the Central Office at Washington advised that all necessary precautions should be taken for the removal of stock and property liable to damage by flood. On the 25th a general alarm was sounded by printing prominently on the local weather map the following warning: "*Red River is rising at all points; ample precautions should be taken for protection of property.*" From this date until the subsidence of the waters all points were kept constantly advised by daily forecasts, through the medium of the telegraph, telephone, the weather map, and the press.

At Arthur City, Tex., which was west of the flood line, the highest stage reached by the river was 25.6 feet on November 26, 1.4 feet below the danger line. At Fulton, Ark., within the flooded district, the river was above the danger line of 28 feet from November 25 to December 8, inclusive, reaching its crest stage of 32.2 feet on December 1. At Shreveport, La., and vicinity, where the maximum intensity of the flood was encountered, the river passed the danger line of 29 feet on December 6 and continued to rise slowly but steadily to a maximum stage of 34.1 feet on December 15 and 16. The water remained above the danger line until December 30, or in all a period of twenty-four days.

The flooded district was approximately 200 square miles in extent and comprised portions of southwestern Arkansas and northwestern Louisiana. That portion over which the greatest damage was wrought was a strip in Caddo Parish, extending in a north and south line for about 25 miles, and in some places over 6 miles in width. It began at an 800-foot crevasse in the levee at Elmer Bayou about 6 or 8 miles below the Arkansas-Louisiana line and extended southward to Shreveport, where the overflow waters again found their way into Red River by the way of Cross Bayou. Farms were badly cut up by the force of the immense volume of water, railroad bridges washed away, growing cotton destroyed, houses flooded, and some live stock drowned. Several towns were deprived of communication, save by boat or telephone, for several weeks. Fortunately but one life was lost, that of a colored man, who was either drowned or died from exhaustion near Gilliam, La. Across the river on the east side, in Bossier Parish, planters suffered considerable loss from overflow water that came in through the back country. The loss of property due to the flood aggregated more than \$500,000, but the value of that saved by the Weather Bureau warnings was easily as much and most likely more, although exact figures can not be given. The work of the Weather Bureau in connection with this flood has been characterized as "of incalculable benefit, as well as preventive of great loss of human life." Hundreds of press notices and letters commendatory in the highest degree have been received. The two following will indicate their general tenor.

Extract from a letter from Mr. H. Hawkins, Secretary of the Shreveport Board of Trade:

The flood warnings sent out by the Weather Bureau before and during the overflow were so accurate and timely that all had ample time to pro-

tect themselves. In consequence of said warnings, there was no loss of live stock and practically no loss of movable property. We have no data from which to compute actual value of property threatened from the overflow, but it runs into the hundreds of thousands. Certainly the Weather Bureau did wonderful work.

From Belcher, La., one of the towns cut off by the flood, Mr. John A. Hall, Postmaster, writes as follows:

The benefits derived from warnings during the recent flood in Red River were incalculable. Ample time was given for the removal of live stock, grain, and produce from lowlands to places of safety. All gave heed to the warnings, which were greatly appreciated. The forecasts were correct in almost every particular, and the work of the Weather Bureau has been highly commended by all.

CANNON AND HAIL.

By Prof. J. R. PLUMANDON, Professor at the University of Clermont-Ferrand and Meteorologist at the Observatory of the Puy de Dome, France, dated January 18, 1903.

From the most ancient times men have had the audacity to fight against storms by threatening Heaven with their weapons. In the time of Herodotus they hurled arrows in the air, to-day they discharge cannon. It is true that they no longer hope to intimidate an angry divinity, but they are convinced that they will be able to conquer nature and destroy storms.

Firing cannon to protect the crops from hail is a usage that goes back to the sixteenth century at least, and which has up to the present time passed through many alternate phases of success and failure, or even periods of complete oblivion. For the last few years we have been witnessing an extraordinary revival of this practise which has acquired a remarkable development in Austria, Italy, and even in some departments of France.

In 1880 and 1884, M. Bombicci, Professor of Mineralogy in the University of Bologna, Italy, maintained that it was possible to prevent the formation of hailstones during thunderstorms by the discharge of cannon which would carry the dust that causes condensation into the midst of the clouds. Some years later, about 1891, basing his views upon the experiments made in Texas, U. S., by General Dyrenforth in order to produce rain, Bombicci even proposed the same method to dissipate hailstorms and force them to discharge only a beneficial rain, or, at most, harmless sleet.

On June 4, 1896, Bombicci's plan was put into execution by M. Stiger, Burgomaster of Windisch-Feistritz, Styria, who made use at first of simple slightly elongated mortars to bombard those clouds that looked stormy. Only a little rain fell, the clouds disappeared and the experimenters attributed this good result to the cannonading. The same results were obtained under analogous conditions in the course of that year, 1896, and also in 1897, so that the cannonading stations began to increase. They numbered 56 in 1898, and at that time mortars, lengthened by the addition of a bell-mouthed chimney, shaped like the trunk of a cone, were used. This is the type of cannon in use at present, and known as "agricole" (agricultural) or "grelifugue" (hail preventing) and which has been perfected so that it renders the firing convenient and rapid.

According to a translation by M. Ottavi, Deputy in the Italian Parliament, the following paragraph occurs in M. Prohaska's official report on the results obtained in Styria during the year 1898:

It may be stated that the firing has produced good results only at Windisch-Feistritz where the success of the two preceding years has been maintained. In the other localities it has not been at all satisfactory. The negative results are all the more surprising since the firing was begun in time and carried on perseveringly. * * * However, although the experiments of 1898 do not justify us in coming to a definite conclusion as to the practise of firing into the clouds it is necessary to continue what has been begun.